

FOUR NEW GARDEN EELS (CONGRIDAE, HETEROCONGRINAE) FROM THE PACIFIC AND INDIAN OCEANS

James E. Böhlke and John E. Randall

ABSTRACT

The four currently recognized genera of heterocongrine eels are here tentatively reduced to two: *Heteroconger* Bleeker and *Gorgasia* Meek and Hildebrand. Three new species of *Heteroconger* and one new *Gorgasia* are named.

H. cobra is described from specimens collected in 30 to 36 m in the Solomon Islands. It has small pectoral fins with 11 to 14 rays, the dorsal-fin origin slightly in advance of to slightly behind gill opening, 198 to 204 vertebrae and a distinctive color pattern of small brown spots on a pale background posterior to gill opening, a large roughly U-shaped blackish mark on head touching gill opening with a dark dorsal bar before it and two similar U-shaped marks on trunk.

H. lentiginosus was collected from the Society Islands and Marquesas in 21 to 41 m. It has small pectoral fins of 11 or 12 rays, the dorsal-fin origin far forward on head (above second lateral-line pore), 173 to 176 vertebrae, and a color pattern of numerous close-set small dark brown spots on a pale background, a pale area nearly devoid of spots on branchial region and a broad brownish bar (from a concentration of dark spots) anteriorly on head.

H. perissodon is described from specimens from Ambon, Indonesia and Negros, Philippines taken in 1 to 10 m. It has small pectoral fins with 11 to 14 rays, the dorsal-fin origin above tips of pectoral fins, 173 to 176 vertebrae and well developed pterygoid tooth patches (between maxillary and vomerine patches); it is brown with an indistinct dark area at anterior end of gill opening preceded by a larger yellowish-white area.

G. preclara was collected from the Philippines and Maldives Islands in the depth range of 24 to 38 m. It has small pectoral fins with 10 to 14 rays, widely-spaced lateral-line pores (only 11 to 16 anterior to anal opening), the dorsal-fin origin behind upper end of gill opening, 144 to 152 vertebrae and a striking color pattern of vertical markings of brownish orange and white.

This paper began with four specimens of the species here named *cobra* that Dr. William F. Smith-Vaniz located in the Australian Museum and brought to Böhlke's attention, knowing of his predilection for these fishes. After a manuscript was prepared, describing the species as new, Randall's unstudied garden eel material surfaced, including more material of *cobra* from the same collection as the original four; this joint contribution is the result.

The institutional abbreviations used are as follows: AMS = Australian Museum, Sydney; ANSP = Academy of Natural Sciences of Philadelphia; BM(NH) = British Museum (Natural History); BPBM = Bernice P. Bishop Museum; CAS = California Academy of Sciences; MNHN = Muséum National d'Histoire Naturelle, Paris; USNM = U.S. National Museum of Natural History; and WAM = Western Australian Museum, Perth.

THE GENERA OF THE HETEROCONGRINAE

Four genera are currently recognized in this subfamily: *Heteroconger* Bleeker 1868, *Taenioconger* Herre 1923, *Gorgasia* Meek and Hildebrand 1923, and *Nystactichthys* Böhlke 1958. A key to their identification was published by Böhlke (1957: 62); *Nystactichthys* (Böhlke, 1958) replaced the preoccupied name *Nystactes*.

The discovery of numerous additional species of garden eels, some of them

with important derived morphological features, makes this generic arrangement untenable. The following are specialized characters of certain heterocongrines, and almost none of the species has been carefully examined except externally: (1) Free upper labial flange continuous around snout tip to include anterior nostrils, anteriormost supraorbital lateral-line pores and, in the case of *halis*, a median ethmoid tooth. This is the condition in all species except those of *Gorgasia*, where the labial flanges are restricted more laterally as in other congrid and the anterior nostrils and anteriormost supraorbital lateral-line pores are on the snout tip between them. These two conditions are illustrated in Böhlke (1957: 69, figs. 1A and B). (2) Presence of a median ethmoid tooth in *halis*. An anterior median tooth, that may point anteroventrally or mostly ventrally and is to a varying extent displaced anteriorly from the premaxillary patch, is present only in this species. The tooth penetrates the upper labial flange. (3) Reduction of the pectoral fin. The fin is moderately developed with about 10 to 14 rays in species of *Gorgasia*, smaller in the species of *Taenioconger* and *Nystactichthys*, and absent from *H. polyzona*. (4) Reduction in number of cephalic lateral-line pores. The species of *Gorgasia* examined have the fullest complement of head pores and pores are variously lost in as yet no apparent sequence in other garden eels. The supratemporal pores have been lost in some, e.g. *polyzona*, *perissodon*, *obscura*, *longissimus*, *halis*. In the preopercular group of the preoperculomandibular series, the first pore is lost in *Gorgasia preclara*, the third pore in such forms as some *perissodon*, *lentiginosus* and *hassi*, and both first and third pores in other species like *obscura*, *halis*, *canabus* and *polyzona*; the pore between those on the lower jaw and the anteriormost preopercular pore is lacking at least in *halis*, *canabus* and *obscura*. In the infraorbital canal the postorbital pores are absent in *halis*, *canabus*, *obscura* and *polyzona*; the posterior suborbital pore is lacking in *halis*; and the anteriormost pore (before the posterior nostril) apparently is absent in *obscura*. Interorbital pores in the supraorbital series are variously lost. The foregoing is incomplete. (5) Dorsal-fin origin. In most species the dorsal fin originates above or slightly before or behind the upper end of the gill opening, or distinctly behind that point. It originates well before the gill opening in *hassi* and even farther forward in *lentiginosus*. The anterior origin is thought to be the derived state. (6) Presence of pterygoid teeth. The holotype of *Taenioconger canabus* Cowan and Rosenblatt (1974) has two "palatine" teeth on the right side only, the only one of 180 specimens examined to have such teeth. The species *perissodon* has a well developed patch of pterygoid teeth present on all of the type specimens, each patch two to four teeth across at its widest point. All other garden eels apparently lack such teeth, as do all other congrid except several nettastomatids. (7) Spacing of the lateral-line pores on the body, especially anteriorly. In nearly all species of heterocongrines numbers of lateral-line pores and vertebrae correspond. The one specimen of *Gorgasia japonica* available for study has 33 lateral-line pores before the anal opening and 78 preanal vertebrae, and in the extreme difference in correspondence, in *G. preclara*, there are 11 to 16 pores and 62 to 67 preanal vertebrae. (8) Color patterns. Most garden eel patterns are nondescript except for those that have lateral-line pores set in white spots. The description of *halis* mentions yellowish-orange spots sprinkled over the entire head and body, *perissodon* is described as having the anterior half of the body flecked with pale bluish and a pale blotch before the gill opening. The extremes in color patterns are: (a) *hassi*, with black blotches at gill openings, mid-trunk and around the anus; (b) *cobra*, with an elaboration on the *hassi* plan, but the individual elements not corresponding; (c) *polyzona*, with rings throughout but lacking a bright color pattern; and (d), *preclara*, with a brilliant pattern of white

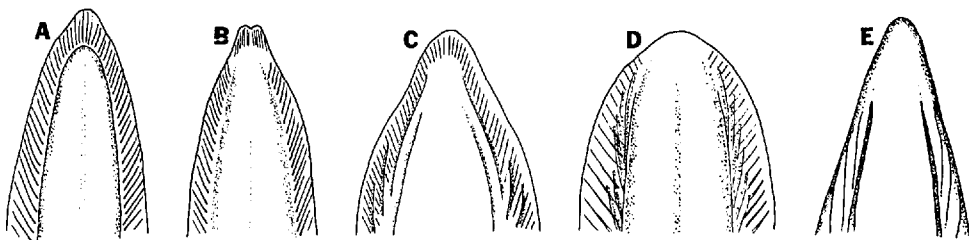


Figure 1. Tips of tails of certain species of *Heteroconger* and *Gorgasia*. A, *Heteroconger cobra*, the usual state; B, *Heteroconger cobra*, an anomalous individual; C, *Heteroconger lentiginosus*; D, *Heteroconger perissodon*; E, *Gorgasia preclara*.

and orange-brown banding and spotting. (9) Posterior maxillary teeth. The posterior maxillary teeth are not modified or only slightly enlarged in many heterocongrines, but reach the extreme of their development in *halis* and *longissimus*, where they are greatly elongated and point forward. (10) Transverse processes on the anterior vertebrae. Rosenblatt (1967) described expanded transverse processes on the anterior vertebrae of *Gorgasia punctata*. (11) Caudal fins. The tips of the tails vary between species and, to an extent, within species. This variation is in the nature of the degree of fleshy covering of the posterior fin rays and consequent visibility of rays and flexibility of the caudal fin. A free fringe of fin around the tail tip is the primitive state in congroids and each foray toward covering of these fin-rays in the tail-burrowing heterocongrines represents a specialization. In some species the tail tips become more fleshy and the rays more difficult to see with growth of the individual. The caudal-fin structure will be a useful character, probably at the specific level, when carefully analyzed for all forms. Species of *Gorgasia* and especially *H. halis* are extreme in having a hard and fleshy tail tip with fin rays not evident and vertical fins terminating externally before the end of the tail.

An analysis of characters will be made when all described garden eels are examined but the species must now be treated within some sort of generic framework. To recognize certain intermediate states on one hand and also to avoid a number of monotypic genera on the other, it seems best at the moment to recognize only the genera *Heteroconger* and *Gorgasia*: *Heteroconger* for all species having the free upper labial flange continuous across the anterior midline and with the anteriormost lateral-line pore and nostril opening on its anterior face, and *Gorgasia* for the species whose anterior pore and nostril open on the snout tip before the free labial flange which is restricted laterally. Randall (1967: 682) already chose not to recognize *Nystactichthys* by relegating *halis* to *Taenioconger*. The tiny pectoral fins of some species of the expanded genus *Heteroconger* provide an insufficient basis to maintain *Taenioconger* as a genus separate from *Heteroconger polyzona*, which totally lacks these fins.

***Heteroconger cobra* new species**
Figures 1A–B, 2–3, and 4A, Table 1

Diagnosis.—Color pattern unique (Figs. 2–3). Pectoral fins, while small, with 11 to 14 rays. Infraorbital and preoperculo-mandibular pore series well developed, former typically with 5 and the latter with 10 pores. Three supratemporal pores. Tip of tail surrounded by visibly rayed fin. Dorsal-fin origin only slightly in advance of to slightly behind gill opening. Total vertebrae 198 to 204, with dorsal fin beginning above vertebra 5 to 7 and anal fin below vertebra 65 to 70.

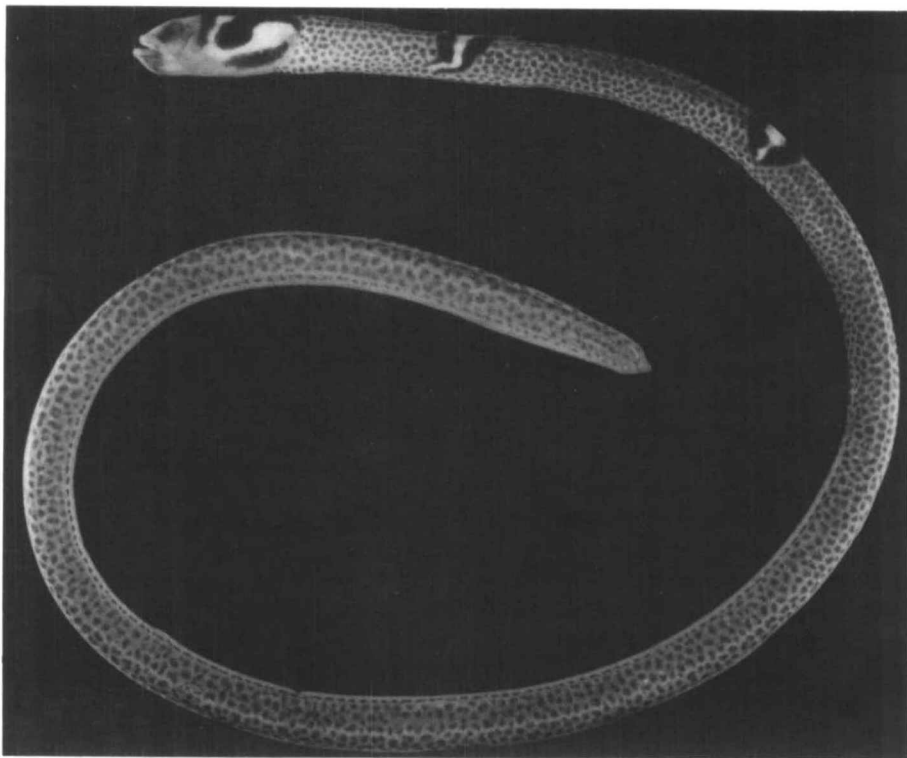


Figure 2. *Heteroconger cobra*, holotype, 349 mm TL, ANSP 142707.

Description.—Body elongate, depth at gill opening 38 to 57 and at anus 53 to 70 times in total length. Body, behind head, compressed, increasingly so posteriad. Dorsal fin originating between slightly before and slightly behind upper end of gill opening; predorsal distance 15 to 21 times in total length. Head short, length to upper end of gill opening 13 to 20 times in total length. Anal-fin origin immediately behind anus. Dorsal, caudal and anal fins confluent, tail tip bluntly pointed (Fig. 1A) except in one anomalous individual (Fig. 1B). Tip of tail somewhat fleshy but easily flexed and fin-rays readily visible.

Narrow median fleshy ridge on top of head, paralleled by groove on either side. Mouth diagonal, lower jaw projecting. Both upper and lower labial flanges well developed, upper wider than lower, and both free across midline. Anterior nostrils opening through anteriorly-directed tubes set in depressions on anterior face of upper labial flange (as shown for another species in Böhlke 1957: 69, fig. 1A). Each posterior nostril simple opening or with raised margins between eye and upper labial flange, placed distinctly laterad of the three snout pores on each side in dorsal aspect.

Snout shorter than large eye. Eye longer than deep. Pupil ovoid, narrower anterior end directed ventrad of main axis of eye. Head finely papillose, strongly grooved ventrally; ridges present on snout, horizontally aligned below eyes, and radiating out from eyes posteriorly and posterodorsally. Gill opening small, mid-lateral, crescentic, lower end posterior to upper. Upper and lower ends of pectoral-fin base posterodorsal to upper and lower ends of gill opening, respectively; fin base broader than gill opening. Pectoral-fin base nearer gill opening at upper

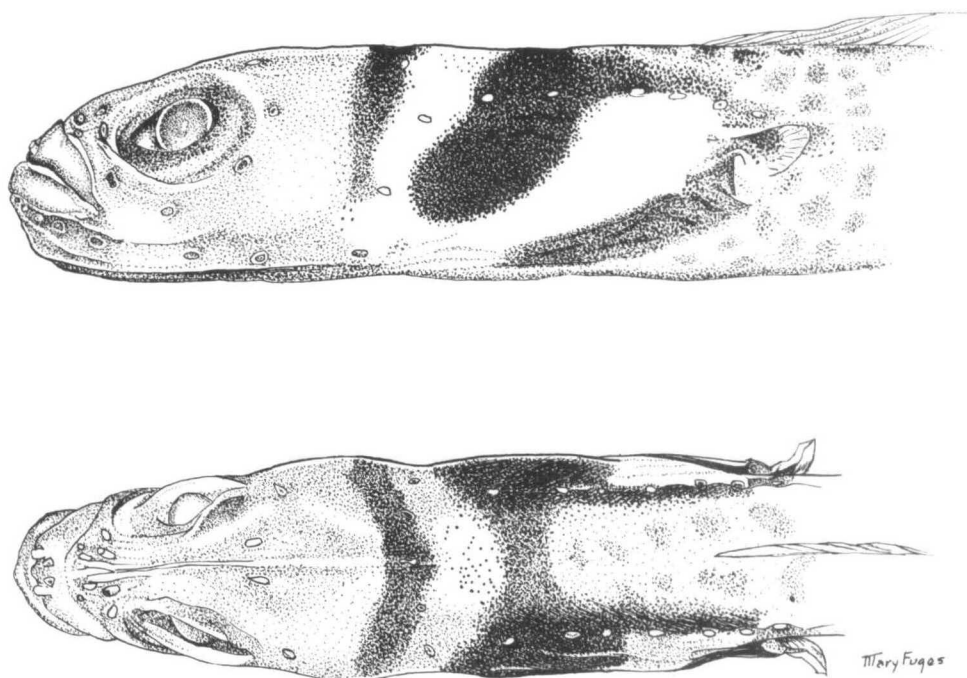


Figure 3. *Heteroconger cobra*, paratype, 340 mm TL, ANSP 142708. Drawings of head to illustrate pores and color pattern.

than at lower end. Pectoral fin small but well formed and distinctly rayed; rays difficult to count but 12 to 14 (most often 12, and a number of counts questioned) on 7 of type specimens.

Dentition consisting of broad patches of small, pointed teeth (Fig. 4A). Maxillary tooth patches four or five teeth across at widest, narrowing to bi- or uniserial about two-thirds way back where they flare laterally in an arc and end posteriorly in one row; posterior, uniserial teeth not enlarged or only slightly so and curved anteriorly. Premaxillary-vomerine patch five or six teeth across at widest point, patch nearly oval with no posterior median teeth, to teardrop-shaped with one or two median teeth posteriorly; premaxillary patches close to maxillary patches anteriorly but visibly distinct from them. Dentary tooth patch four or five teeth across at widest, narrowing to biserial posteriorly. Tongue free, well developed.

Lateral-line pores on head typically: four in supraorbital canal, five in infraorbital canal, ten in preoperculomandibular canal, and three in supratemporal commissure (Fig. 3).

Pore variation (seven specimens); two individuals, including holotype, have a pore above eye on left side and two others have pores on right—each a single pore just before vertical through mid-eye except that a cluster of three pores replaces one of them. In infraorbital series, postorbital pore replaced by two pores, close together, on both sides of one fish. Usually five pores on chin, but two eels have six on one side (including holotype—left side) and three have four on one side. One specimen has additional pore between dentary and preopercular pores on both sides, lacks right supratemporal pore, and has region of nostril and anteriormost infraorbital pore anomalous on right side; this also is fish with cluster

of three pores above eye. Before anal opening there are 63 to 65 lateral-line pores (7), anteriormost in large dark blotch of Figure 3; pore in front of first lateral-line pore in illustration is from preoperculomandibular canal; total pore count of 188 on one specimen.

Coloration in Alcohol.—The unique and striking color pattern alone (Figs. 2 and 3) distinguishes this species from all other described heterocongrines.

Color consists of brown spots and markings on white to pale brown background. Dark markings on head and trunk dark brown, almost black, and pale areas enclosed by the white. Some variation in details of dark head pattern, but essentially as illustrated. On specimens other than illustrated, two trunk markings sometimes more U-shaped in lateral aspect; saddles of two sides correspond and white centers continuous across dorsal midline as bar. On some specimens white center of anterior saddle heart-shaped when viewed from above. On body, the palest background, bluish white, in gut region. In lateral aspect pale region deepest immediately behind head, where underlies skin of ventral two-thirds of body depth; narrows ventrally posteriorly until terminating short distance posterior to anus. Above and posterior to gut cavity background brown, paler near tail tip than at midbody.

Chin dark, as are edges of upper and lower lips adjacent to outer tooth rows.

Remarks.—Color pattern of *H. cobra*, while highly distinctive, is most like that of *hassi* and this seems surely where its closest relations lie. Black trunk blotch of *hassi* does not conform in position to either of the saddles of *cobra* but these markings are similar elements in the overall patterns of the two species. Part of dark pattern on the head crosses just in front of pectoral fin in *cobra*, but fin is not surrounded by and included in black blotch as in *hassi*. *H. cobra* lacks black blotch that *hassi* possesses around anus. On the other hand, dark pattern of *cobra* more complex than that of *hassi*.

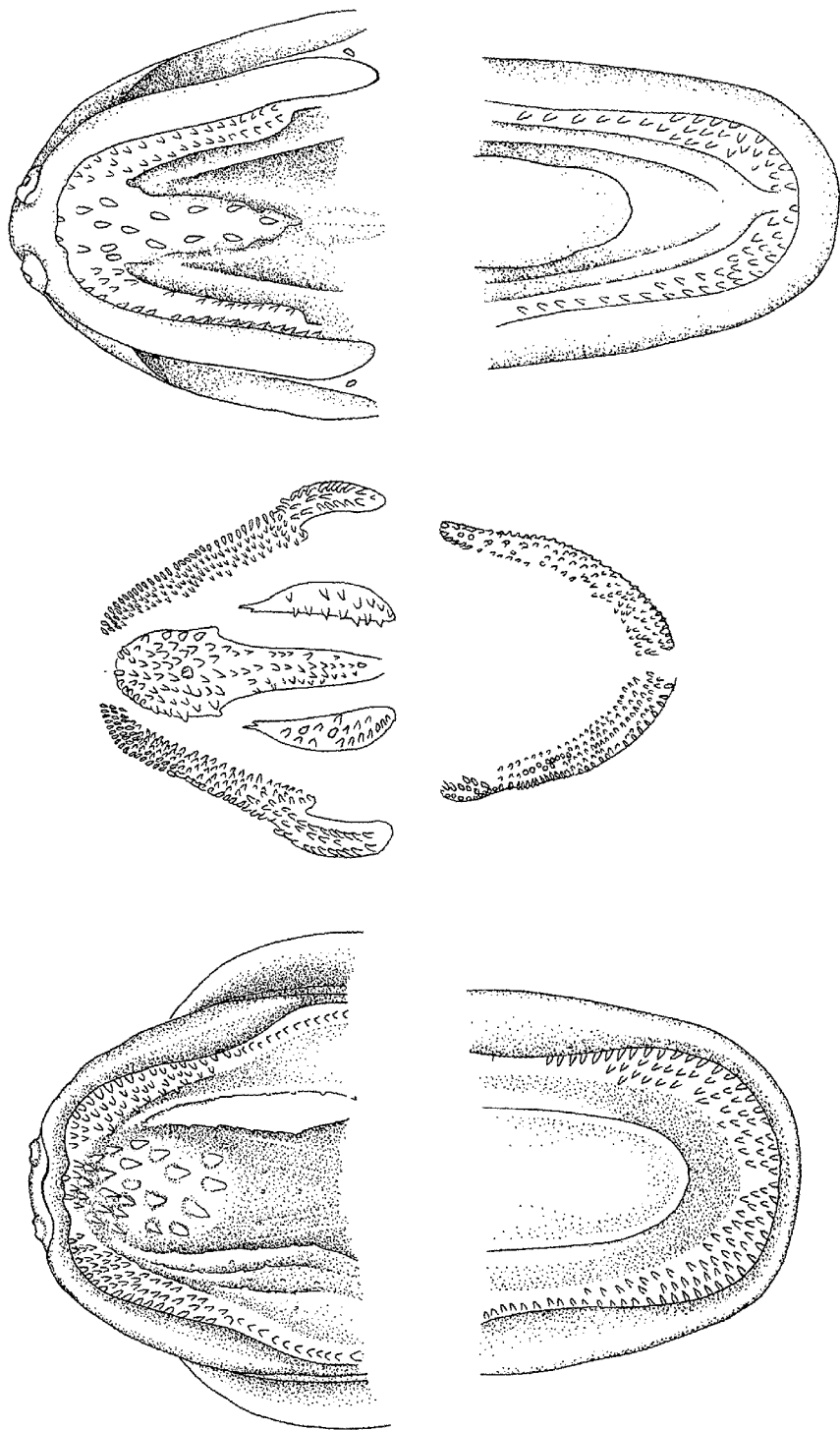
Heteroconger cobra has more vertebrae than *hassi*, having a total of 198 to 204, with first anal-fin ray below vertebra 65 to 70. *H. hassi* has a total of 163 to 176, with first anal-fin ray below vertebra 59 to 66 (these ranges for the material listed below).

Etymology.—The name *cobra* is after the vernacular name of the snake, in allusion both to color pattern and posture in life; to be treated as an appositional noun.

Material Examined.—HOLOTYPE: ANSP 142707, 349 mm total length, Solomon Islands, Guadalcanal, near wreck of Japanese transport ship 7 mi W of Honiara; sloping sand bottom ca. 100 ft off stern of wreck on offshore side; 30–36 m; 7 July 1973; J. E. Randall, Gerald R. Allen, Michael McCoy. Black and white photograph taken.

PARATYPES. AMS I17481-003 (2, 349.5–402), ANSP 142708 (1, 340, illustrated), ANSP 142709 (1, 366), BM(NH) 1976.7.5.22–23 (2), BPBM 16002 (3, 156–362), CAS 36818 (2, 340–356) and USNM 216167 (2, 323–331), all taken with holotype.

Material of *Heteroconger hassi* Examined.—ANSP 94706 (1, 237), Maldives, Rasdu-Atoll; paratype of *Xarifania hassi* Klausewitz and Eibl-Eibesfeldt (1959: 138). ANSP 128308 (5, 104–283.5), Cocos-Keeling Islands, eastern Indian Ocean, Horsburgh Island, ca. 1 km off SW tip of island, 12°05'02"S, 96°51'07"E; 24–30 m; 28 March 1974; W. F. Smith-Vaniz, P. L. Colin; sta. 63. ANSP 128310 (2, 267–271), Cocos-Keeling, same data as 128308; 29 March 1974; sta. 64. ANSP 128309 (3, 100–287), Cocos-Keeling, Turk Reef, N side, 12°06'30"S, 96°49'35"E; 24 m; 13 March 1974; P. L. Colin; sta. 32. ANSP 128247 (1, 291), Fiji, Viti Levu, E side of Mbengga Island, ca. 20 mi SW of Suva Harbor; 25 m; 14 April 1974; W. F. Smith-Vaniz, B. Carlson, P. L. Colin; sta. 1. ANSP 142532 (2, 219–261, incomplete) and BPBM 22760 (1, 121.5) Ryukyu Islands, Yaeyama Group, Kuroshima; 20 m; early October 1979; Masami Irie, Itsuro Miyawaki, Shu Inoue; quinaldine. BPBM 13495 (1, 293), Palau Islands, Malakal Channel; 10.5 m; 24 December 1971; G. R. Allen; spear. BPBM 16147 (2, 329–345), Solomon Islands, Florida Island, Sandfly Passage; 6.5 m; 19 July 1973; B. Goldman; spear. BPBM 12196 (2, 284–294),



Marshall Islands, Eniwetok Atoll, pinnacle reef in lagoon near deep channel; 36 m; sand, some rubble; 29 January 1972; J. E. Randall, G. R. Allen; rotenone; black and white photograph taken of larger. BPBM 17456 (1, 158), American Samoa, Tutuila, W side of Aunuu Island; 30 m; sand bottom; 4 May 1974; J. E. Randall, R. C. and C. A. Wass; rotenone.

Heteroconger lentiginosus new species

Figures 1C, 5upper and 6, Table 1

Diagnosis.—Color pattern unique (Fig. 5upper). Pectoral fins, while small, with about 11 or 12 rays. Infraorbital and preoperculomandibular pore series well developed, former with 5 and latter with 8 to 10 pores (see below). Three supratemporal pores. Tip of tail surrounded by visibly rayed fin. Dorsal-fin origin far forward on head, above second lateral-line pore. Total vertebrae 173 to 176 with dorsal fin beginning above vertebra 1 to 3 and anal fin below vertebra 65 to 68.

Description.—Body only moderately elongate, depth at gill opening 33 to 43 and at anus 41 to 46 times in total length. Body, behind head, compressed, becoming more so posteriad. Dorsal fin originating far forward on head; predorsal distance 20 to 25 times in total length. Head comparatively long, length to upper end of gill opening 13 to 16 in total length. Anal-fin origin immediately behind anus. Dorsal, caudal and anal fins confluent; vertical fins somewhat shorter at tail tip than farther forward, but fins continuous, clearly rayed and flexible around tip.

Fleshy median ridge on top of head, paralleled by groove on either side. Mouth diagonal, lower jaw projecting. Both upper and lower labial flanges well developed, upper wider than lower, both free across midline. Anterior nostrils opening through anteriorly-directed tubes set in depressions on anterior face of upper labial flange (as shown in Böhlke, 1957: 69, fig. 1A). Each posterior nostril simple opening or with raised margins between eye and upper lip, placed distinctly laterad of three snout pores on each side in dorsal aspect.

Snout shorter than large eye. Eye longer than deep. Pupil ovoid, narrower anterior end directed ventrad of main axis of eye. Head finely papillose anteriorly and highly grooved throughout. Gill opening small, mid-lateral, crescentic, lower end posterior to upper. Lower end of pectoral-fin base at level of lower end of gill opening; upper end of pectoral-fin base at level of upper end of gill opening or slightly above. Pectoral fin small but well formed and distinctly rayed; rays difficult to count, 11 or 12 counted on one side of each of 3 specimens.

Dentition consisting of broad patches of small pointed teeth. Maxillary tooth patches about four to six teeth across at widest, narrowing to one or two rows less than two-thirds the way back where they flare laterally in an arc. Teeth in posterior third of maxillary patch uniserial, slightly to decidedly enlarged and their tips directed anteroventrally to anteriorly. Premaxillary-vomerine patch broad anteriorly, irregularly four to six teeth across at widest, tapering to point posteriorly or not, patch considerably shorter than maxillary patches. Dentary tooth patch irregularly four or five rows across at widest point, tapering to one or two rows wide posteriorly. Tongue free, well developed.

In preoperculomandibular series of pores one pore in opercular area before and below level of first lateral-line pore, three pores in preopercular area forming

←

Figure 4. Dentition of: Bottom: *Heteroconger cobra*, paratype, 340 mm TL, ANSP 142708; Middle: *Heteroconger perissodon*, paratype (stained), ANSP 136746; and Top: *Gorgasia preclara*, paratype, 219 mm TL, ANSP 142711. In the text A is Bottom, B is Middle and C is Top.



Figure 5. Upper, *Heteroconger lentiginosus*, holotype, 375.5 mm TL, BPBM 12591. Lower left, *Heteroconger perissodon*, paratype, 387 mm TL, BPBM 18543. Right, *Gorgasia preclara*, holotype, 299 mm TL, BPBM 21012.

angle of more than 90 degrees, one pore midway between anteriormost preopercular pore and lower-jaw pores, and four on lower jaw. Supraorbital pores five: two on snout, posterior nostril laterad of midway between them, one above anterior half of eye or mid-eye, and one above posterior part of eye; additional pore on each side mesad of anterior nostril on anterior face of upper labial flange. Infraorbital pores five: one on snout anteromesad to posterior nostril, one below anterior part of eye, one below about mid-eye, one behind lower part of eye, and one behind mid-eye. Three supratemporal pores.

Pore variation: Only one individual has upper (third) preopercular pore present on both sides and two others have this pore on right side only. While there are more counts of two preopercular pores in type series, the three-pored condition was described above because it is assumed primitive one. One individual has small

Table 1. Measurements expressed as thousandths of total length or (*) head length of holotype and paratypes of four new garden eels (Heterocongrinae)

	<i>Heteroconger cobra</i>			<i>Heteroconger lentiginosus</i>			<i>Heteroconger perissodon</i>			<i>Gorgasia preclara</i>		
	Holotype	Range	Mean	Holotype	Range	Mean	Holotype	Range	Mean	Holotype	Range	Mean
Number of specimens		10			5			6			10	
Total length (mm)	349	156-402	318	375.5	185-375.5	258	537	315-537	387	299	215-323	260
Predorsal length	53.3	47.2-67.3	54.8	40.2	40.2-49.8	45.9	59.4	59.4-70.3	65.7	65.9	65.9-75.4	71.3
Preanus length	341	336-391	358	397	397-414	406	323	323-363	349	438	432-470	454
Head length†	55.6	48.7-76.9	57.6	61.2	61.2-78.4	68.7	52.0	52.0-65.1	58.4	58.2	58.2-70.7	64.8
Depth at gill opening	20.0	17.4-26.3	20.0	25.8	23.1-30.5	26.8	19.9	19.9-24.0	22.6	20.7	19.3-23.9	21.5
Width at gill opening	11.2	11.2-15.4	12.8	18.4	16.7-20.5	18.0	15.3	15.3-19.0	17.4	14.0	12.7-15.4	14.2
Depth at anus	14.3	14.2-18.7	15.8	22.6	21.8-24.6	22.8	18.2	18.0-21.6	19.2	18.2	15.8-20.1	18.2
Width at anus	13.2	11.9-14.7	13.0	21.0	17.9-21.1	19.8	15.8	14.7-17.8	16.1	17.6	15.7-19.0	17.6
Eye diameter*	191	191-233	206	174	174-223	204	150	150-190	167	210	176-218	200
Snout length*	144	125-146	138	117	117-153	133	136	124-146	136	126	109-141	124
Upper jaw length*‡	201	176-209	196	213	184-213	196	176	176-222	202	256	207-256	224
Gill opening depth*	61.8	60.1-77.5	65.9	95.6	70.1-111	96.7	57.3	57.3-106	74.3	60.3	60.3-107	75.7
Longest pectoral ray*	61.8	56.8-76.9	65.3	82.6	58.5-92.4	73.8	78.8	78.8-139	120	80.4	78.3-108 [§]	94.2
Fleshy interorbit width*	—	109-150 [§]	126	143	143-162	156	133	133-190	156	132	98.4-132	119

† From snout tip to upper end of gill opening.
‡ From snout tip to angle of skin covering rear of maxillary, not to end of maxillary bone.
§ Four specimens only.
¶ Nine specimens only.

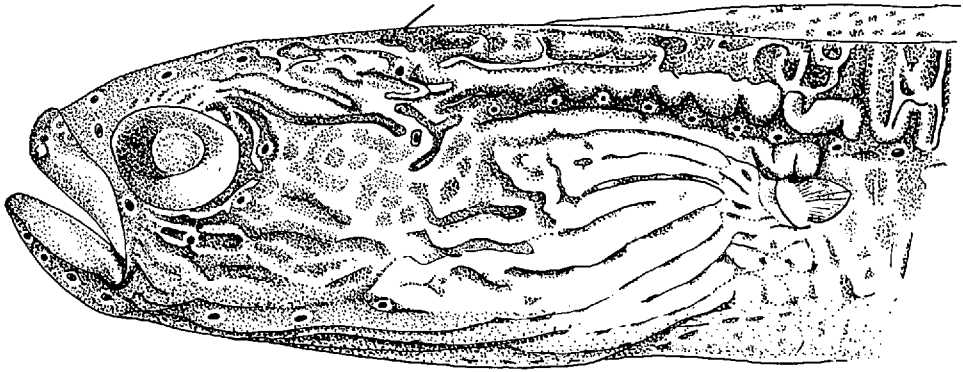


Figure 6. *Heteroconger lentiginosus*: head of holotype, 375.5 mm TL, BPBM 12591.

supernumerary pore in infraorbital series on left side just in advance of second normal pore. Two specimens have five pores on lower jaw on right side only, one has six. Lateral-line pores above or before anterior rim of anal opening 63 or 64 (5), behind that point 97 to 105 (5), total 161 to 168 (5).

Color in Alcohol.—Generally with brown freckles on pale background. Fins brown-spotted. Posterior half of head pale laterally and ventrally, especially so in young; in lateral aspect, brown dots extend ventrally into pale area anteriorly, shape of extension somewhat reminiscent of lateral head marking of *H. cobra*. In young, lateral and ventral surfaces of head anterior to the pale region uniform dark brown, except for chin and lips which are pale. In larger individuals, dark area accentuated along its anterior border by still darker diagonal lateral slash.

Live color notes describe fish as "yellowish white with numerous small black spots; anteroventral part of head blackish" (Tahiti) or "white with olive dots" (Fatu Hiva, Marquesas).

Remarks.—Like *Heteroconger cobra*, this species also probably is allied with *H. hassi*; its pigment pattern is like that found on the tail of *hassi*. It, however, lacks the five characteristic black blotches found on the anterior half of *hassi*. Dorsal-fin origin in *hassi* farther forward than in most garden eels, beginning above vertebra three through six; in *lentiginosus*, however, it is farthest forward, above one of first three vertebrae.

The range of total vertebral counts for *hassi* includes the number for this species but there are fewer preanal vertebrae in *hassi* (refer to Remarks for *cobra*).

Etymology.—The name *lentiginosus* is from the Latin, meaning freckled, to be used in the masculine because *Conger* is masculine.

Material Examined.—HOLOTYPE: BPBM 12591, 375.5 mm total length, Marquesas Islands, Nuku Hiva, NW side of Sentinelle de l'Est; 21 m; 14 May 1971; David Bryant; spear. Color and black and white photographs taken by J. E. Randall. Head illustrated.

PARATYPES. ANSP 142715 (1, 239.5) and ANSP 142716 (1, 239, cleared and stained), Marquesas Islands, Fatu Hiva, off point at N end of Hunau Bay; 35 m; sand; 21 April 1971; J. E. Randall, D. B. Cannoy, R. M. McNair; black and white photographs and one in color taken of ANSP 142715. CAS 45888 (1, 251.5), Society Islands, Tahiti, Papara, Teavaraa Pass; 30 m; sand bottom; 21 Septem-

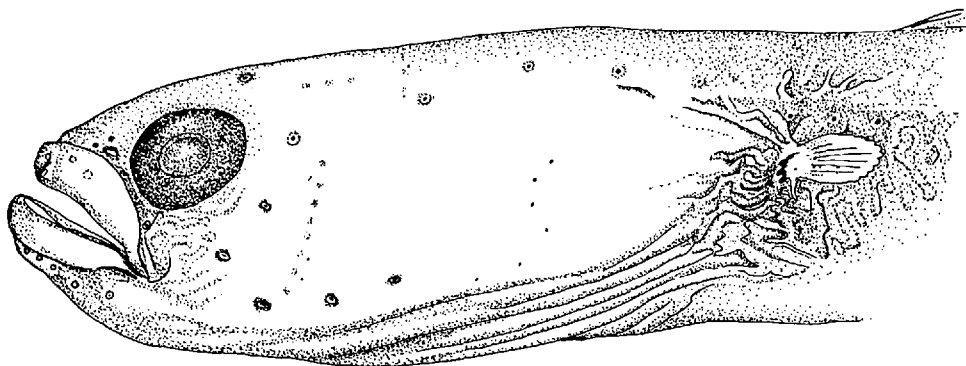


Figure 7. *Heteroconger perissodon*: head of paratype, 375 mm TL, ANSP 142731.

ber 1967; J. E. Randall, E. Reese; "Chemfish"; black and white photograph taken. USNM 221379 (1, 185), Marquesas Islands, Tahuata, off point at S end of Vaitahu Bay; 35–41 m; sand and rubble bottom; 23 April 1971; J. E. Randall, D. B. Cannoy, J. Haywood; rotenone.

***Heteroconger perissodon* new species**
 Figures 1D, 4B, 5middle and 7, Table 1

Diagnosis.—Color brown, darkest anteriorly, paler posteriorly. Smudgy area at gill opening, preceded by large diagonal pale area that variously extends forward at lower, anterior end. Pectoral fins, while small, with 11 to 14 rays. Infraorbital and preoperculomandibular pore series well developed, former with 5 and latter with 8 or 9 (9 the more frequent) pores. No supratemporal pores. Tip of tail hardened, not flexible, caudal rays not readily visible; caudal-fin rays abruptly shorter than posterior dorsal- and anal-fin rays. Dorsal-fin origin behind head, above tips of appressed pectoral fins. Well developed pterygoid tooth patches present, between maxillary and vomerine patches. Total vertebrae 173 to 176, with dorsal fin originating above vertebra 8 to 11 and anal fin below vertebra 58 to 62.

Description.—Body elongate, depth at gill opening 42 to 50 and at anus 46 to 56 times in total length. Body, behind head, compressed, becoming increasingly so posteriad. Dorsal fin originating behind head, above tips of appressed pectoral fins; predorsal distance 14 to 17 times in total length. Head length 15 to 19 in total length. Anal-fin origin immediately behind anus. Dorsal, caudal and anal fins confluent, but caudal-fin rays reduced in length and with fleshy covering. Posterior dorsal- and anal-fin rays long, but caudal-fin rays abruptly shortened.

Fleshy median ridge on top of head, paralleled by groove on either side. Mouth diagonal, lower jaw projecting. Both upper and lower labial flanges well developed, upper wider than lower, both free across midline. Anterior nostrils opening through anteriorly-directed tubes set in depressions on anterior face of upper labial flange (as shown in Böhlke, 1957: 69, fig. 1A). Each posterior nostril simple opening between eye and upper lip, placed distinctly laterad of three snout pores on each side in dorsal aspect.

Snout shorter than large eye. Eye longer than deep. Head and body anteriorly heavily papillose; head with five rows of sensory organs, with dark pigmentation, postorbitally. One row crosses nape at location of supratemporal commissure; short, separated row extends forward on each side, perpendicular to latter and

at level of dorsal margin of eye in dorsal aspect; curving row extends down and forward from behind mid-eye to just behind pore preceding first preopercular pore. Gill opening small, crescentic, highly convoluted, lower end posterior to upper. Upper end of pectoral-fin base just above upper end of gill opening and lower end just above lower end of gill opening. Pectoral fins small but well formed and distinctly rayed; rays number 12/14 on stained paratype and 11 to 13 on one side of each of 4 other paratypes.

Teeth small and numerous (Fig. 4B). Maxillary tooth patches about 5 or 6 teeth across at widest, tapering to two or three far posteriorly; posteriorly maxillary patches flare laterally in an arc where rear teeth are slightly to moderately enlarged and directed anteroventrally. Dentary tooth patches about six or seven rows across at widest point anteriorly and biserial to broader posteriorly. Vomerine tooth patch broad, about seven or eight teeth across at widest and not tapering to single series until far back in roof of mouth, continued behind posterior terminus of maxillary series; vomerine teeth increasingly more broad-based and blunter from front to rear, none notably elongated. Patch of pterygoid teeth present on each side between vomerine and maxillary tooth patches, each two to four teeth across at widest point. Tongue free, well developed, that of holotype bearing two teeth.

In preoperculomandibular series of pores one pore in opercular area before and slightly below level of first lateral-line pore, two pores in preopercular group, one pore between preopercular pores and those on lower jaw, and four or five pores on lower jaw. Supraorbital pores four: one mesad of anterior nostril on anterior face of upper lip flange; two on snout, the posterior mesad of posterior nostril; and one posteriorly on interorbit. Infraorbital pores five: one before anterior nostril, two below eye and two behind eye. No pores in supratemporal commissure.

Pore variation: In preoperculomandibular series one individual has only single preopercular pore on left side only, and there are seven counts of five pores on lower jaw, five counts of four. In supraorbital series holotype anomalous, with five pores on left side (three on snout posterior to lip flange) and only three on right side (interorbital pore lacking). In infraorbital series holotype has six pores, additional pore below eye. On right side of one individual additional pore present from temporal (lateral) canal behind eye, midway between eye and preoperculomandibular canal junction. The 387-mm fish has extra pore on left side beneath labial flange, before posterior nostril; it is not clear to which canal it belongs.

Lateral-line pores before anterior rim of anal opening 54 to 59, behind that point 95 to 103, total 151 to 160 (154 to 160 except for the specimen with 151, which has several gaps in spacing of pores behind anus).

Coloration in Alcohol.—Body brown, darkest anteriorly, becoming increasingly pale to tail tip. Fins pale. Anterior margin of gill opening smudgy, margined anteriorly by diagonally elongate pale area. Lower two-thirds of head paler than body behind gill opening.

In life, color of a 396-mm specimen (measured fresh) recorded by Randall as follows: "Olivaceous brown; about the anterior half of body finely flecked with pale bluish; a dark blotch at anterior end of gill opening preceded by a yellowish white spot of larger size (this color mark visible under water); edge of median fins white."

Remarks.—The well-developed patches of pterygoid teeth immediately distinguish this species from all others (see no. 6 in "The genera of the Heterocongrinae" above). The color features of a smudgy blotch at anterior end of gill opening

preceded by a larger yellowish-white area are distinctive. The tail tip is broad in outline, but hardened.

Etymology.—The name *perissodon* is from the Greek words meaning extraordinary (in numbers) and tooth, referring to the extra teeth possessed by this species.

Material Examined.—**HOLOTYPE**: BPBM 21017, 537 mm total length, Philippines, Negros, off Dumaguete City pier; 10 m; silty sand; 30 August 1977; J. E. Randall; powerhead blast; color and black and white photographs taken.

PARATYPES. ANSP 136746 (1, anterior portion, cleared and stained), taken with the holotype. ANSP 142731 (1, 375, illustrated), BPBM 18543 (1, 387), CAS 45889 (1, 315), MNHN 1980-1190 (1, 385), USNM 221380 (1, 321.5), and WAM P26788-001 (1, 324), Indonesia, Molucca Islands, Ambon, Poka, NW side of Ambon Bay (NE side of point at oil company recreation site); 1 m at low tide; 8 February 1975; J. E. Randall, G. R. Allen; rotenone; color and black and white photographs of BPBM 18543.

***Gorgasia preclara* new species**
Figures 1E, 4C, 5C and 8, Table 1

Diagnosis.—Color pattern of broader brownish-orange and narrower white rings alternating anteriorly, white rings becoming bars and progressively decreasing in extent posteriorly (Fig. 5 lower). Pectoral fins, while small, with 10 to 14 rays. *Lateral-line pores on body, and particularly those before anus, unusually widely spaced, only 11 to 16 anterior to anal opening*. Infraorbital and preoperculomandibular pore series well developed, former with 6 and latter with 8 or 9 pores. Supratemporal pores 3. Vertical fins terminating exteriorly before tail tip, tail tip fleshy with caudal-fin rays usually not readily visible. Dorsal-fin origin shortly behind level of upper end of gill opening. Total vertebrae 144 to 152, with dorsal fin originating above vertebra 6 to 9 and anal fin below vertebra 62 to 67.

Description.—Body elongate, depth at gill opening 42 to 52 and at anus 50 to 63 times in total length. Body, behind head, somewhat compressed, wider at anus than at gill opening, becoming compressed toward tail tip. Dorsal fin originating shortly, but consistently, behind level of upper end of gill opening; predorsal distance 13 to 15 times in total length. Head length 14 to 17 in total length. Anal-fin origin immediately behind anus. Dorsal, caudal and anal fins confluent, but caudal-fin rays included in fleshy covering; dorsal- and anal-fin rays terminating externally before tail tip.

No fleshy ridge paralleled by grooves on top of head. Mouth diagonal, lower jaw projecting. Both upper and lower free labial flanges well developed, upper wider than lower at widest, neither free across anterior midline. Narrow frenum separating free lips of two sides on lower jaw; upper free labial flange terminating anteriorly laterad of nostrils and anteriormost infraorbital pore. Anterior nostril at snout tip, with short fleshy tube whose margin may or may not be entirely free from surrounding skin. Posterior nostril simple opening in low mound between anterior nostril and eye, placed laterad of anterior supraorbital pores in dorsal aspect and with anteriormost infraorbital pore between it and anterior nostril.

Snout shorter than large eye. Eye longer than deep; pupil diagonally elongate, anterior end directed anteroventral to main axis of body. Snout, interorbit and chin finely papillose. Gill opening small, crescentic, lower end posterior to upper. Upper end of pectoral-fin base slightly above upper end of gill opening and lower end distinctly above lower end of gill opening; pectoral-fin base diagonal so that lower end considerably farther from gill opening than upper end. Pectoral fins small to moderate, rounded, distinctly rayed; rays number 9 to 14 on 10 specimens counted (number of counts questionable).

Teeth with tips slightly recurved, unspecialized. Premaxillary portion of con-

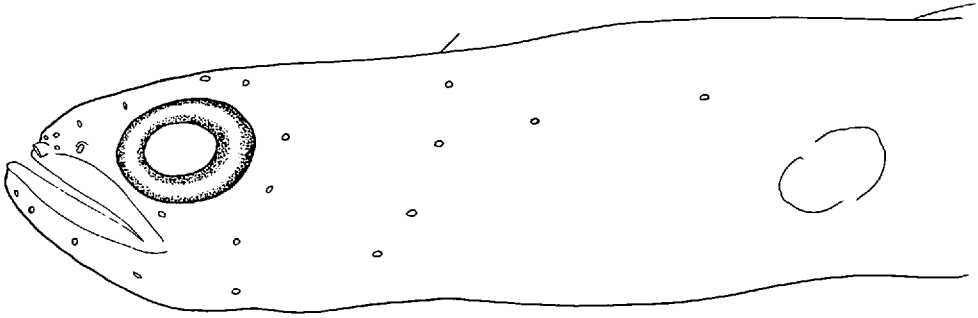


Figure 8. *Gorgasia preclara*: head of paratype, 323 mm TL, ANSP 142732.

tinuous premaxillary-vomerine tooth patch rounded, posteromedian teeth largest or nearly all teeth equal in size. Vomerine portion three teeth across at its widest, narrowing to uniserial posteriorly; uniserial portion of patch may be as short as a single median tooth; vomerine teeth terminating posteriorly well in advance of ends of maxillary patches. Maxillary patches three to five teeth across at widest, narrowing to one or two teeth wide posteriorly (usually uniserial and often to the extent of only the last few teeth); inner rows dropping out and outer continuing to end of series. Dentary tooth patches three or four teeth across at widest, narrowing to uniserial one-third to somewhat more than one-half way back; outer row dropping out first and inner row continued back as a single one. Tongue free, well developed.

In preoperculomandibular series of pores one pore in opercular area before and slightly below level of first lateral-line pore, two or three pores in preopercular group, one pore between preopercular pores and those on lower jaw, and three to five pores on lower jaw. Supraorbital pores six: three on snout and three on interorbit; anteriormost posteromesad to anterior nostril and last at level of posterior limit of eye. Infraorbital pores five or six, typically five with one pore before posterior nostril, two below eye and two behind eye. Three supratemporal pores.

Pore variation: In preoperculomandibular series two individuals have on one side an additional pore above third preopercular pore; preopercular group more often with two pores, anterior missing [counts on both sides of 12 specimens: 2(18) 3(6)], and second pore on one side of one fish paired; pores on lower jaw of 12 specimens: 3 (1), 4 (20), 5 (3). In supraorbital series one specimen has an additional, seventh, pore on one side, located behind upper part of eye. Four of 12 individuals show variation in infraorbital series: on three (one side of one, both sides of two) an added pore in infraorbital series beneath labial flange, below front of eye; on one an extra pore below eye on left side only; and on one only one pore behind eye on left side only.

Lateral-line pores before anterior rim of anus number: 11 (1), 12 (3), 13 (2), 14 (3), 16 (1) (two of the pores close together); behind that point are 45 to 56; total 58 to 69.

Coloration in Alcohol.—Head usually pale back to shortly behind eyes, sometimes with dark spot on interorbit. Diagonal pale bars present or absent behind eyes; when present variously interconnected ventrally with other pale lateral markings. Pale nuchal bar. Usually a pale spot on either side in branchial region, spots of two sides sometimes interconnected across dorsum. Pale areas narrowly

margined by brown that is darker than general brownish area between them (except in two specimens from Maldives).

On body 9 to 11 (usually 10) narrow pale bands between gill opening and anterior margin of anus (each pale band with a lateral-line pore in its field), with wider brownish bands separating them; again, pale bands narrowly margined with darker brown. Pattern fades rapidly in preservative and distinction between pale and darker areas quickly pales posterior to anus. Edge of dorsal fin with dark spots and lines.

See Figure 5 lower for the magnificent color pattern of this fish shortly after death.

Remarks.—The highly distinctive color pattern and greatly reduced number of lateral-line pores, most notably before anus, distinguish this species from all other garden eels. Some species of *Gorgasia* lack patterns on the body while others have lateral-line pores set in pale or white spots. The well-developed pattern of the present species might be considered an extension of the latter—with fewer pores set in more extensive pale areas.

Etymology.—Named *preclara*, from the Latin, very beautiful or splendid.

Material Examined.—HOLOTYPE: BPBM 21012, 299 mm total length, Philippines, Sumilon Island (E of S end of Cebu Island); 24–29 m; rubble and sand bottom, ca. 45° slope; 26 August 1977; J. E. Randall; rotenone; color and black and white photographs taken.

PARATYPES. ANSP 142713 (1, 280), ANSP 142710 (1, 263, cleared and stained), ANSP 142732 (1, 323, head illustrated), BPBM 21013 (1, 287), BPBM 22135 (4, 275–331.5), CAS 45890 (1, 219.5), MNHN 1980-1191 (1, 323) and USNM 221381 (1, 328.5), taken with the holotype. The 311-mm specimen in BPBM 22135 photographed in color by J. E. Randall. ANSP 142712 (1, 236.5) and BPBM 21015 (2, 229–265.5), Philippines, Luzon, Caban Island (near Maricaban Island), N side; 30 m; sand-rubble slope; 2 September 1977; J. E. Randall, K. Carpenter, W. Einzinger; rotenone. ANSP 142714 (1, 244), Philippines, Luzon, Batangas, SW side of Caban Island; 30 m; sand-rubble slope; 28 July 1978; J. E. Randall, G. Tribble, R. Rutherford, K. Carpenter; rotenone. ANSP 142711 (1, 219, teeth illustrated) and BPBM 22597 (1, 215), Maldive Islands, Villingili, Male Atoll, N side of island; 38 m; rubble and sand bottom; 6 March 1979; J. E. Randall, G. R. Allen, R. C. Steene; rotenone.

ACKNOWLEDGMENTS

For the loan of material, we thank Dr. W. Klausewitz of the Natur-Museum und Forschungs-Institut Senckenberg, Frankfurt am Main; Dr. G. R. Allen of the Western Australian Museum, Perth; and Dr. D. F. Hoese of the Australian Museum, Sydney. The illustrations are by M. H. Fuges. E. B. Böhlke supplied the x-rays and helped to assemble the manuscript. Dr. C. R. Robins assisted with the formation of new species names. Dr. V. G. Springer gave permission to stain a specimen of *Heteroconger polyzona* that he had collected in the Philippines. This work was supported in part by the National Science Foundation (NSF-DEB 7620325) to J.E.B. We are grateful to the National Geographic Society for providing grants for field work in the Solomon Islands and French Polynesia (J.E.R.).

LITERATURE CITED

- Bleeker, P. 1868. Description de trois especes inédites de poissons des îles d'Amboine et da Waigou. Versl. Meded. K. Akad. Wet. Amst. (2) 2: 331–335, 1 pl.
- Böhlke, J. E. 1957. On the occurrence of garden eels in the western Atlantic, with a synopsis of the Heterocongrinae. Proc. Acad. Nat. Sci. Phila. 109: 59–79, pl. 4.
- . 1958. Substitute names for *Nystactes* Böhlke and *Lucaya* Böhlke, preoccupied. Copeia 1958: 59.
- Cowan, G. I. McT., and R. H. Rosenblatt. 1974. *Taenioconger canabus*, a new heterocongrin eel (Pisces: Congridae) from Baja California, with a comparison of a closely related species. Copeia 1974: 55–60.
- Herre, A. W. C. T. 1923. A review of the eels of the Philippine Archipelago. Phil. J. Sci. 23: 123–236, 11 pls.

- Klausewitz, W., and I. Eibl-Eibesfeldt. 1959. Neue Röhrenaale von den Maldiven und Nikobaren (Pisces, Apodes, Heterocongridae). Senckenberg. Biol., 40: 135–153.
- Meek, S. E., and S. F. Hildebrand. 1923. The marine fishes of Panama. Part 1. Publ. Field Mus. Nat. Hist., (215) Zool. Ser. 15: xi + 330 p.
- Randall, J. E. 1967. Food habits of reef fishes of the West Indies. Stud. Trop. Oceanogr. (5): 665–847.
- Rosenblatt, R. H. 1967. The osteology of the congrid eel *Gorgasia punctata* and the relationships of the Heterocongrinae. Pacif. Sci. 21: 91–97.

DATE ACCEPTED: July 28, 1980.

ADDRESSES: (JEB) *The Academy of Natural Sciences, Nineteenth and the Parkway, Philadelphia, Pennsylvania 19103*; (JER) *Bernice P. Bishop Museum, P.O. Box 6037, Honolulu, Hawaii 96818*.